Implementation of Mask Shape BTC Content Based Image Retrieval for Semantic Gap

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Abstract: This paper attempts to discuss the evolution of the retrieval techniques focusing on development, challenges and trends of the image retrieval. It highlights both the previously addressed and outstanding issues. The explosive growth of image data leads to the need of research and development of Image Retrieval. However, Image retrieval researches are moving from keyword, to low level features and to semantic features. Content Based Image Retrieval is an interesting topic of research since years. Specifically, it is on developing technologies for bridging the semantic gap that currently prevents wide-deployment of image content-based search engines. Mostly, content-based methods are based on low-level descriptions, while high-level or semantic descriptions are beyond current capabilities. In this paper, we will try to implement the technique to fill this gap. When it comes to image retrieval, we have taken into account a very primary feature of the signal namely content. This feature is used as parameter for comparison and retrieval from the previously stored image databases.

Keywords: Image Retrieval, CBIR, MBTC, Kekre’s Algorithm.

I. INTRODUCTION

Retrieval is the wide topic of research from the decades, because it is a challenge to reduce the semantic gap. Basically retrieval of data means to get desired data from the database. It may image, text, audio or video as per requirement of user. The basic types of retrievals are mentioned in figure(1). From ages images have been the mode of communication for human being. Today we are able to generate, store, transmit and share enormous amount of data because of the exhaustive growth of Information and Communication Technology. Much of this information is multimedia in nature, which consists of digital images, video, audio, graphics, and text data. But all that information is only useful if one can access it efficiently. From ages images have been the mode of communication for human being. Today we are able to generate, store, transmit and share enormous amount of data because of the exhaustive growth of Information and Communication Technology. Much of this information is multimedia in nature, which consists of digital images, video, audio, graphics, and text data. But all that information is only useful if one can access it efficiently. This does not only mean fast access from a storage management point of view but also means that one should be able to find the desired information without scanning all information manually. Previous method used for image retrieval is Text based image retrieval. The advantage of textual indexing of image is that it can provide user with key word searching, catalogue browsing and even with query interface. But the major drawback of text based image retrieval are, annotation depends on the person who adds it, the user of a Text Based Image Retrieval must describe an image using nearly the same keywords that were used by the annotator in order to retrieve the image. Due to all these drawbacks, Content Based Image Retrieval is introduced.

Fig.1. Types of Retrieval.

In content based image retrieval techniques the term “Content-based” means the search made by analyzing the contents of stored images in database rather than their associated text i.e. keywords, or other kind of descriptors. In this context the content may refers to colors, shapes, and textures features. Additionally, that can also include any other information that derived from image can be used as content of the image. The key reason behind development of CBIR is the limitation of text based image retrieval systems. Textual information about images can be easily searched using various existing technology, but this requires huge human efforts to describe image and their contents. Additionally due to linguistic issues such as use of different words in different regions for description can also affect the performance of image search. Therefore search by text in image context is not much suitable. Therefore in this presented work, the image search is performed using the query by image, and by the content based analysis of image data. The key reason behind
to use the query by image is that an image describes better, their own content as compared to the descriptor or keyword. Thus first of all query image is produced over the retrieval system and their content features i.e. shape using edge detection technique, color using color movement technique and texture using the available binary pattern is estimated. In addition of for defining the domain of the given images the saliency features of the images are also recovered. By using these features the similar feature images are extracted from the data base.

II. CBIR TECHNIQUES

In this method, a given image is first divided into sub-block which has the same size and then the color and edge direction features of each sub block can be extracted. Next, it constructs a codebook of color feature using clustering algorithm and then each sub-block is mapped to the codebook. The color feature is used to retrieve images, and the edge direction feature is the weight of the similarity measure for the color feature. To improve the accuracy of CBIR Using Gradient Projections, the image’s structural properties were examined to distinguish one image from another. By examining the specific gray level of an image, a gradient can be computed at each pixel. Pixels with a magnitude larger than the thresholds are assigned a value of 1. These binary digits are added across the horizontal, vertical, and diagonal directions to compute three projections. Dr H B Kekre, S D Thepade et al. introduced Image Retrieval with Shape Features Extracted using Gradient Operators and Slope Magnitude Technique with BTC and tested on generic image database with 1000 images spread across 11 categories. The average precision and recall of all queries are computed and considered for performance analysis. Gradient operators used for shape extraction were Robert, Prewitt and Sobel which are known as „Mask-Shape-BTC“ CBIR techniques. The problem with these Mask-Shape-CBIR methods is the need of resizing the database images to match it with the size of query. This drawback is removed using proposed Mask-Shape-BTC-CBIR methods.

III. BLOCK TRUNCATION CODING (BTC)

Block truncation coding (BTC) is a simple image coding technique developed in the early years of digital imaging. This method first divides the image to be coded into small nonoverlapping image blocks typically of size 4x4 pixels to achieve reasonable quality. The small blocks are coded one at a time. For each block, the original pixels within the block are coded using a binary bit-map the same Upper Mean Color (UM) size as the original blocks and two mean pixel values. The method first computes the mean pixel value of the whole block and then each pixel in that block is compared to the block mean. If a pixel is greater than or equal to the block mean, the corresponding pixel position of the bitmap will have a value of 1 otherwise it will have a value of 0. Two mean pixel values one for the pixels greater than or equal to the block mean and the other for the pixels smaller than the block mean are also calculated. At decoding stage, the small blocks are decoded one at a time. For each block, the pixel positions where the corresponding bitmap has a value of 1 is replaced by one mean pixel value and those pixel positions where the corresponding bitmap has a value of 0 is replaced by another mean pixel value. It was quite natural to extend BTC to multi-spectrum images. Most color images are recorded in RGB space, which is perhaps the most well-known color space. As described previously, BTC divides the image to be coded into small blocks and code them one at a time. For single bitmap BTC of color image, a single binary bitmap the same size as the block is created and two colors are computed to approximate the pixels within the block. To create a binary bitmap in the RGB space, an Inter Band Average Image (IBAI) is first created and a single scalar value is found as the threshold value. The bitmap is then created by comparing the pixels in the IBAI with the threshold value.

IV. PROPOSED CBIR TECHNIQUES

The paper proposes Mask Shape BTC“ image retrieval techniques using four different gradient operators (Roberts, Sobel, Prewitt and Canny) using slope magnitude technique and BTC. The performance of proposed image retrieval methods is compared with „Mask Shape“ based CBIR techniques.

V. MASK-SHAPE CBIR

In „Mask-Shape“ CBIR the shape feature vector is formed by applying slope magnitude method on Gradient of image in vertical and horizontal directions. This feature vector is considered for finding the similarity of query image with database images. The problem of this technique is that all the images in the database must have same dimensions as that of query image. The selection of gradient operators like Robert, Sobel, Prewitt and canny results into four variations of „Mask-Shape“ based image retrieval.

VI. MASK-SHAPE-BTC CBIR

The problem of having all the database images with same size for image retrieval can be resolved using proposed „Mask Shape BTC“ based CBIR methods. Here firstly, the shape features of the image are extracted by applying slope magnitude method on gradients of the image in vertical and horizontal directions and then the BTC is applied on obtained „Mask Shape“ images to have a shape feature vector with constant size irrespective of size of the image considered. Even in „Mask shape BTC“ based image retrieval four variations are considered using different gradient operators.

- We create a database containing images, the images are registered in the database. These images will be forwarded to Feature Vector Module i.e. fusion of MBTC and patterns generation. The resulted feature vector will be stored in feature vector database.
- Feature vector generation: (a) MBTC is applied on each image to calculate uppermean and lowermean. (b) Uppermean and lowermean are 3-dimensional matrix i.e. it has three components red, green, blue. Three components are separated from uppermean and lowermean matrix. (c) Each component is quantized to equivalent value of pattern matrix. (d) Then occurrence of each pattern in six components i.e. uppermean(RGB)
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and lower mean (R,G,B) matrix is counted and arranged as (8x12) matrix for each image in database.

- Using above procedure feature vector is also calculated for query image.
- Now feature vector of query image is compared with feature vector of images in database using Euclidian distance concept.
- Then Euclidian distance is arranged in ascending order and according to Euclidian distances images are retrieved as result.
- Images are then retrieved according to different thresholds (thresholds for Euclidian distances) and precision, recall calculated for each threshold value.

Where,

\[
\text{Precision} = \frac{\text{total no. of retrieve relevant images}}{\text{total no. of relative images}}
\]

The precision rate of the implemented system is described in the figure, the computed precision values are demonstrated using the Y axis of the given figure and the X axis of the figure shows the amount of training images in the database. According to the obtained results the performance of the proposed system is increases as the amount of data in database is increases. In addition of the precision rate is growing continuously as the similar kinds of images are also increases in database.

![Fig.2. Precision Rate](image-url)

Recall values are measured for accuracy measurement in terms of relevant document retrieved or relevant data obtained according to the input user query. This can be evaluated using the following formula

\[
\text{Recall} = \frac{\text{total no. of retrieve relevant images}}{\text{total no. of relative images in database}}
\]

The figure shows the recall values of the proposed image retrieval application. In order to represent the performance of the proposed image retrieval system the X axis contains the amount of images in database and the Y axis reports the obtained recall rate of the implemented system. According to the obtained results the performance of the proposed system is enhances as the amount of data is increases in the database. The retrieval accuracy with the increasing amount of data is also increases thus the proposed concept is adoptable for the image search applications.

![Fig.3. Recall](image-url)

Images are retrieved using Euclidian distance and Absolute distance. Then precision and recall calculated for both techniques and compared to know which one is better.

A. Segmentation using Fast Codebook Generation Algorithm

A. Kekre’s Fast codebook generation algorithm (KFCG) This algorithm reduces the time of code book generation. Initially we have one cluster with the entire training vectors and the code vector C1 which is centroid. In the first iteration of the algorithm, the clusters are formed by comparing first member of training vector with first member of code vector C1. The vector Xi is grouped into the cluster 1 if xi1< c11 otherwise vector Xi is grouped into cluster2. In second iteration, the cluster 1 is split into two by comparing second member xi2 of vector Xi belonging to cluster 1 with that of the member c12 of the code vector C1. Cluster 2 is split into two by comparing the member xi2 of vector Xi belonging to cluster 2 with that of the member c22 of the code vector C2. This procedure is repeated till the codebook size is increased to the size specified by user. It is observed that this algorithm gives minimum error and requires least time to generate codebook as compared to other algorithms. Given image is divided into regions using vector quantization techniques and then the regions are merged based on color threshold and volume threshold values. The proposed technique has two steps to follow:

- Region forming using vector quantization technique
- Region merging Region forming: To form regions Kekre’s Fast codebook generation algorithm (KFCG) is used.

In each vector quantization technique 2 types of training vectors are formed. x Each training vector is of dimension three consisting of R, G, B components of one pixel. x Each training vector is of dimension twelve consisting of R, G, and B components of 2 x2 adjacent pixels. The size of codebook
is set to eight. Training vectors are reassigned to encoding regions in every iteration. Once the code book size reaches eight the process is stopped. In the original image pixel value is replaced by the encoding region number to which the pixel is assigned. Region merging: Region merging based on color similarity is performed after region formation as a posteriori step. All pixels pertaining to each segmented region have exactly the same label. Thus, a single scan through the labeled image suffices to compute the mean color and volume of each region. The labeled image is then scanned successively to combine two adjacent regions

VII. CONCLUSION
This paper provides a study of image retrieval work towards narrowing down the ‘semantic gap’. Recent works are mostly lack of semantic features extraction and user behavior consideration. Therefore, there is a need of image retrieval system that is capable to interpret the user query and automatically extract the semantic feature that can make the retrieval more efficient and accurate.

VIII. REFERENCES

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